Radiant Points deduced from the Paths of 4,143 *Shooting Stars observed by the Members of the Italian Meteoric Association in the year* 1872. By W. F. Denning, Esq.

The radiant points given in the table which follows were determined by the projection of the meteors in the Catalogue entitled *Osservazioni di stelle cadenti fatte dai membri dell' Associazione Meteorica Italiana durante l'anno* 1872. (Milan 1874). The book contains 7,512 paths in all, numbered progressively; but of these no less than 3,621 (Nos. 2684 to 6304) are for August 4–13, and chiefly *Perseïds*, which it was not considered essential to examine thoroughly. The number of meteors projected was 4,143, and the radiant points deduced therefrom 315, of which, however, a large number are duplicates of the same showers. Less than 200 distinct systems are probably shown. The meteors examined and resulting radiants for each month were as follow:—

No. in Table.	Period of Observations.	Length in days.	Meteors Projected.	Numbers in Catalogue.	Radiants Reduced.
I.	Jan. 1–15	15	313	1 to 313	30
II.	Feb. 1—Mar. 12	42	381	344 „ 724	24
III.	Mar. 31—April 12	13	542	731 „ 1272	37
IV.	May 3–15	13	269	1319 „ 1587	22
V.	May 26—June 13	19	356	1588 „ 1943	31
VI.	June 26—July 11	16	459	1961 „ 2419	36
VII.	July 15—Aug. 2	18	264	2420 „ 2683	27
VIII.	Aug. 6–12 (A.M.)	7	413	2900 „ 6274	25
IX.	Aug. 24—Sept. 14	22	455	6307 „ 6761	36
X.	Oct. 29—Nov. 13	16	255	6820 „ 7074	24
XI.	Nov. 25 to Dec. 31	37	436	7077 „ 7512	23

Thus the observations (and reductions) are broken up into periods of from about 13 to 22 days. The intervening voids were caused by moonlight. In two cases (Feb.–March and Nov.–Dec.) I incorporated two following sets of observations, because the radiants were generally the same, and the meteors observed, if taken singly, insufficient to indicate many of the positions accurately. Only 413 of the large number between August 4–13 were projected. These were seen in the mornings, and nearly all of them selected as probably belonging to radiants eastwards of the *Perseïds*, and perhaps to new showers or to showers feebly observed before. There are no reductions for October, only 37 meteors having been observed during that month. The tracks were pencilled upon the star charts prepared by the Luminous Meteor Committee of the British Association for the use of their observers. Some difficulty was occasionally

found in getting at the radiant points, for the shooting stars recorded during several of the periods presented singular discordances in their directions, and were a very confused mass, requiring much care in assigning the true centres. In such cases it is obviously very important to consider the length of path and observed velocity of the individual meteors. The difficulty mentioned in sorting them arose not so much from errors of observation as from the large number of showers in contemporaneous operation, and the closely bordering positions of some of them.

The majority of the radiants in the table agree with showers previously discovered and included in the catalogues of Greg and Herschel, Heis, Schmidt, Schiaparelli and Zezioli, Tupman, and others, and accord in many instances with the resulting radiants from my own observations of shooting stars during the last two years. A proportion of the showers are new, and a few of them apparently rich systems (agreeing in several cases with cometary dates and radiants), which it will be desirable to re-observe and confirm in future years.

The chief radiant points observed were the *Perseïds* (August 1–13) and *Andromedes* (November 27). A number of minor systems were also fairly active; and to what extent may be found by a reference to the table, in which I have given the number of meteors conforming to each radiant; but the figures relating to this detail should not be considered exact. In cases where a meteor converged on two or more radiants in the same line it may have been counted twice over, and when far away from the radiant one will sometimes have been omitted altogether. Precision in this matter is not very important.

Many of the showers endured apparently for much longer periods than is usually attributed to them. Thus the *Perseïds* (or a succession of coincident radiants in *Perseus*) continued in feeble action during the whole of the last five months of the year, and the *Coronaids* were seen between March and July. Many additional samples of long duration will be found on inspecting the table, and my own observations are strongly corroborative in this particular. It appears certain that shooting stars continue to fall, and sometimes abundantly, from radiant points long after the first and maximum display, which usually occurs when the radiant is near the apex of the Earth's way.

In going over this Italian catalogue a few observed peculiarities struck me which may be worthy of note here. On May 3 Signor Maggi, at Volpeglino (who appears to have been one of the most successful of the observers), saw three meteors in succession with identical paths. They were of the 2nd mag., and very swift, the observed tracks being from 238°+78° to 16°+88°, and belonging to the radiant No. 11, IV., in the table, from which others were seen on the same night. The same observer recorded on Aug. 10, $11^h\ 19^m$ to $15^h\ 19^m$, five shooting stars also with exactly similar paths, namely, from 91°+59° to 101°+59° (*see* Nos. 4971, 4981, 5062, 5080, 5146).

Another was seen on the same night from 91°+59° to 98°+60° (No. 5102). These foreshortened paths conform to the radiant in *Auriga*, No. 10, VIII. Nos. 4997, 4998, and 5007 supply another instance of similar paths (15°+35° to 1°+14°, *β Andromedæ* to *γ Pegasi*), and belonged to the *Perseïds*. Not many stationary meteors were registered during the year. One at 76°+46° (No. 5017 1st mag.), on August 10, strongly supports the shower No. 11, VIII. Another at 33°+33° (No. 3001), on August 5, agrees with No. 19, VIII. A fireball, comparable to the Moon, was seen stationary by Maggi on August 25, at 10°+7° (No. 6319). He also noted a meteor at 48°+49° (No. 5036), without movement, on August 10. The latter observation is valuable as confirmation of the radiant No. 14, VIII., in *Perseus*, which is a well-marked shower in August, and quite distinct to the ordinary *Perseïds*, at about 44°+56°. Other stationary meteors seen registered as follows: at 146°+9°, on April 3 (No. 926); at 163°+58°, on May 9 (No. 1512); at 191°+47°, on May 15 (No. 1586); and at 215°+16°, on July 3 (No. 2186).

The length of the meteor paths, as given in this catalogue, is, I believe, greater as a rule than the average in the lists of Zezioli, Heis, or Tupman, a large number of which I have recently been engaged in examining.

So far as can be judged by comparing the resulting radiants with those obtained by previous observers, and more lately by myself, the meteors in this Italian catalogue appear to have been very carefully and accurately registered.

Ashleydown, Bristol,
January 1878.

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Radiant Points of Shooting Stars, deduced from Observations by the Members of the Italian Meteoric Association in the year 1872. By W. F. Denning.

No. of Radiant.	I. Jan. 1–15. 313 Meteors. Radiant. R.A. °	Dec. °	No. of ↓s.	II. Feb. 1–March 12. 381 Meteors. Radiant. R.A. °	Dec. °	No. of ↓s.	III. March 31–April 12. 542 Meteors. Radiant. R.A. °	Dec. °	No. of ↓s.	IV. May 3–15. 269 Meteors. Radiant. R.A. °	Dec. °	No. of ↓s.	V. May 26–June 13. 356 Meteors. Radiant. R.A. °	Dec. °	No. of ↓s.	VI. June 26–July 11. 459 Meteors. Radiant. R.A. °	Dec. °	No. of ↓s.	VII. July 15–August 2. 264 Meteors. Radiant. R.A. °	Dec. °	No. of ↓s.	VIII. August 6–12 A.M. 413 Meteors. Radiant. R.A. °	Dec. °	No. of ↓s.	IX. August 24–Sept. 14. 455 Meteors. Radiant. R.A. °	Dec. °	No. of ↓s.	X. Oct. 29–Nov. 13. 255 Meteors. Radiant. R.A. °	Dec. °	No. of ↓s.	XI. Nov. 25–Dec. 31. 436 Meteors. Radiant. R.A. °	Dec. °	No. of ↓s.	No. of Radiant.
1	184	+52	6	182	+56	20	209	+ 6	25	202	+ 7	14	201	+11	9	53	+62	7	47	+57	6	44	+56	—	45	+57	12	47	+56	4	46	+57	7	1
2	109	+34	8	105	+30	12	201	+18	15	202	+17	17	293	+14	22	290	+15	20	291	+17	5	100	+71	38	339	+46	24	100	+71	5	132	+76	8	2
3	178	+35	9	180	+36	12	184	+35	15	186	+36	8	288	+55	15	279	+59	26	284	+60	9	283	+63	6	280	+60	9	280	+70	5	285	+79	5	3
4	80	+23	11	83	+24	15	228	− 5	9	229	− 4	18	273	− 3	11	273	− 2	20	272	+ 4	7	61	+39	35	67	+35	10	62	+36	10	62	+38	9	4
5	164	+35	5	158	+28	21	162	+34	13	162	+34	10	312	+22	16	313	+20	7	320	+23	11	70	+64	31	64	+65	13	73	+65	9	68	+65	7	5
6	49	+61	7	53	+66	13	204	− 8	7	209	− 8	9	343	+16	8	344	+12	9	337	+14	10	50	+75	28	40	+73	10	45	+70	6	40	+70	8	6
7	130	+24	7	129	+22	19	139	+16	8	252	+47	8	250	+45	5	250	+48	10	349	− 1	6	50	+85	4	68	+84	15	54	+ 6	10	79	+57	7	7
8	155	+64	10	145	+55	5	157	+45	12	150	+45	7	257	+30	14	255	+37	12	256	+37	11	92	+56	18	100	+56	10	100	+60	6	265	+65	4	8
9	104	+53	13	133	+67	10	133	+66	20	135	+68	10	233	+60	15	250	+62	18	233	+68	7	76	+33	21	78	+23	8	78	+37	7	245	+65	4	9
10	228	+53	8	260	+66	6	258	+60	20	315	+55	6	312	+63	5	310	+51	13	318	+49	9	81	+57	17	315	+47	9	189	+57	8	180	+64	3	10
11	221	+43	7	111	+62	22	232	+54	17	233	+47	24	305	−10	8	303	+ 7	7	302	+ 7	4	75	+45	13	343	+ 9	11	147	+ 2	6	346	+47	7	11
12	241	+63	6	28	+35	16	170	+78	7	180	+79	6	285	± 0	8	15	+35	11	13	+29	12	4	+31	4	10	+34	20	9	+37	6	102	+48	5	12
13	100	+42	6	101	+44	12	106	+52	10	175	+26	6	353	+39	7	8	+54	6	8	+54	15	52	+20	11	302	+ 9	9	62	+20	13	64	+15	7	13
14	104	+14	7	177	+10	32	179	+ 9	15	170	−10	9	35	+47	7	163	+59	9	167	+55	5	49	+47	11	44	+43	7	157	+17	8	26	+46	202	14
15	204	+45	8	205	+51	7	206	+44	30	210	+48	18	215	+55	17	216	+47	10	351	+53	11	45	+24	8	45	+20	8	45	+26	7	48	+32	7	15

16	140+77	8	147+ 4	17	147+ 1	7	203+39	9	10+80	6	64+46	10	65+51	12	60+48	22	63+48	12	62+47	10	105+14	6	16
17	40+77	8	300+80	12	215+83	10	300+79	7	279+77	10	290+82	8	315+60	10	87+34	8	180+75	10	135+21	12	330+66	6	17
18	65+65	10	77+60	9	235+25	19	241+26	9	246+21	9	248+22	16	30+47	10	34+50	3	286+45	5	160+40	8	170+84	5	18
19	140+30	6	210+70	14	210+66	22	218+62	7	215+70	7	210+62	7	23+37	7	33+33	7	34+35	14	130+45	8	110+35	10	19
20	150+43	7	10+60	8	23+62	5	247+57	8	5+17	5	335+26	10	337+28	9	347+36	4	140+76	5	180+32	6	24+27	4	20
21	245+72	7	106± 0	5	265+38	31	265+38	15	278−35	5	291+45	8	294+40	10	47+32	9	310+67	12	157+30	4	120+40	5	21
22	258+45	5	55+19	8	229+35	6	251+ 8	10	266+ 8	9	261+11	14	294− 7	6	135+66	8	252+36	5	140+66	7	125+65	4	22
23	120+46	8	123+46	5	231+ 7	17			238+13	8	235+ 7	14	287+27	10	87+15	5	17+61	23	136+11	5	20+56	7	23
24	195+63	5	288+12	6	277+10	7			192+35	7	188+29	9	260+63	5	17+ 5	5	300+82	14	88+ 7	7			24
25	120+15	6			216+14	8			214+16	12	215+16	7	285+44	8	5+20	6	24+44	7					25
26	157+13	6			338+61	18			337+59	10	325+66	8	338+64	6			342+59	11					26
27	135+48	6			195− 6	6			258−14	19	269−13	12	330+42	6			358+20	11					27
28	168+ 3	5			190+20	12			248− 3	7	253− 5	7					235+65	9					28
29	200+58	7			223+23	14			286+36	15	278+35	29					329+ 9	5					29
30	110+70	8			262± 0	10			332± 0	8	325+ 3	9					15+10	10					30
31					255+27	9			315+32	22	315+33	15					270+20	7					31
32					304+12	9					24+61	10					240+25	6					32
33					151+23	7					290+70	11					333+27	12					33
34					278+46	8					320−12	6					280+30	6					34
35					287+27	5					344+46	13					260+50	5					35
36					91+58	6					27+50	7					216+49	5					36
37					183+62	7											240+46	4					37